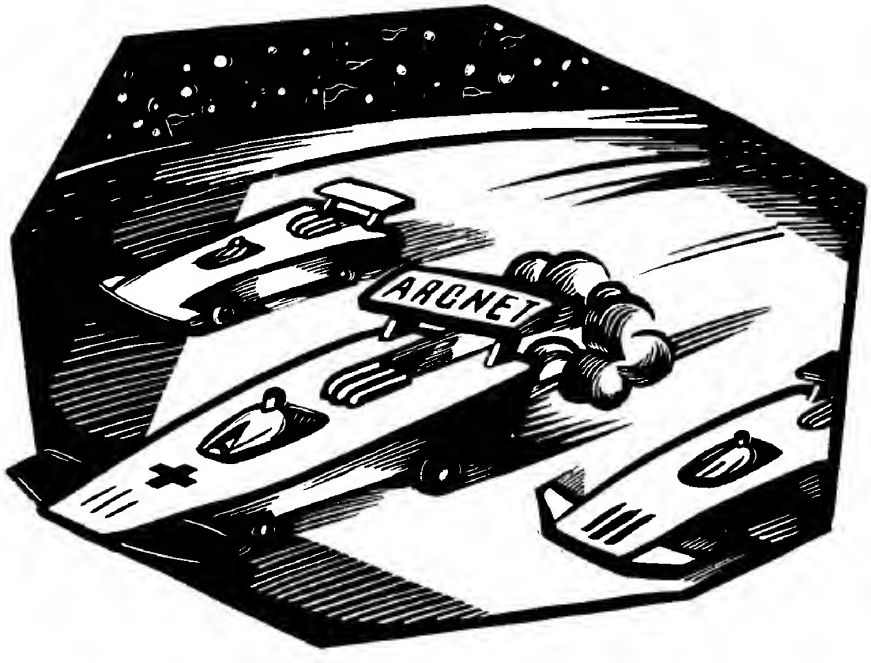
THE RETURN OF ARCNET

The new 20-Mbps ARCnet specification is fast and downward-compatible



ARCnet, one of the oldest and most robust LAN architectures, is about to be turbocharged. While ARCnet transfers data at 2.5 megabits per second—significantly slower than Ethernet or Token Ring—the soon-to-be-released ARCnet Plus will leapfrog both, turning in transfer rates of 20 Mbps. What's more, unlike any other LAN standard that's undergone a speedup, ARCnet Plus will be downward-compatible with older ARCnet equipment.

Most people think of Ethernet as the first commercial LAN standard, but that's not the case. Introduced by Datapoint in 1977, ARCnet (which stands for Attached Resource Computing Network) was doing an excellent job integrating clusters of business workstations and intelligent terminals when Ethernet was still an experiment at Xerox's Palo Alto Research Center.

ARCnet's Slow Start

Although it was first to market, ARCnet fell behind Ethernet for several reasons. First, Datapoint kept the technology proprietary for several years, implementing it only on its own business computing systems. The first publicly available ARCnet chips were not sold until 1982, by which time Ethernet had already become popular. In addition, Datapoint—unlike Xerox, DEC, and Intel—didn't participate in the IEEE 802 committee meetings, which made Ethernet and Token Ring international standards. Finally, the fact that Datapoint was not an industry giant with the clout of these other companies may have kept the word from getting out.

Nonetheless, ARCnet is still an attractive standard, and many LAN managers have embraced it. One of ARCnet's main draws is that it uses 92-ohm coaxial cable, which is the same kind used with IBM 3270 terminals and which typically costs half as much per foot as the 50-ohm coaxial cable used with Ethernet. This means that many existing structures, such as airports and older office buildings, may not need to be rewired for ARCnet, since it can run over the web of existing cable that was installed (often at great expense) for mainframe terminals. Other implementations run over twisted-pair and fiber-optic cable, and you can use ARCnet on the IBM Cabling System with 92-ohm baluns.

Another ARCnet advantage is its robustness. ARCnet was so heavily overdesigned that it works amazingly well even when connectors are loose, cable runs are too long or out of spec, or grounds are faulty or absent. An ARCnet that's built around "active" hubs—which is the recommended configuration—won't go down if you disconnect a node or forget to terminate a cable. And ARCnet's "modified token-passing" protocol, which requires that the hardware acknowledge every transaction, including passage of the token, provides a high degree of confidence that a message has been delivered.

Token passing in an ARCnet makes the network *deterministic*. That is, there is a fixed upper bound on the amount of time a station must wait before transmitting, so no one station can hog all the bandwidth.

ARCnet has a small minimum packet size, which makes it especially good at dealing with applications, such as data entry and terminal emulation, that involve the exchange of many small packets. Finally, there's price. ARCnet remains the low-cost leader. PC adapters

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ITEMS DISCUSSED

ARCnet
ARCnet Plus
Datapoint Corp.
9725 Datapoint Dr.
San Antonio, TX 78229
(800) 334-9968
(512) 699-7000
fax: (512) 699-7920
Inquiry 1227.

can be had for as little as $75; typical low-end Ethernet cards cost twice as much.

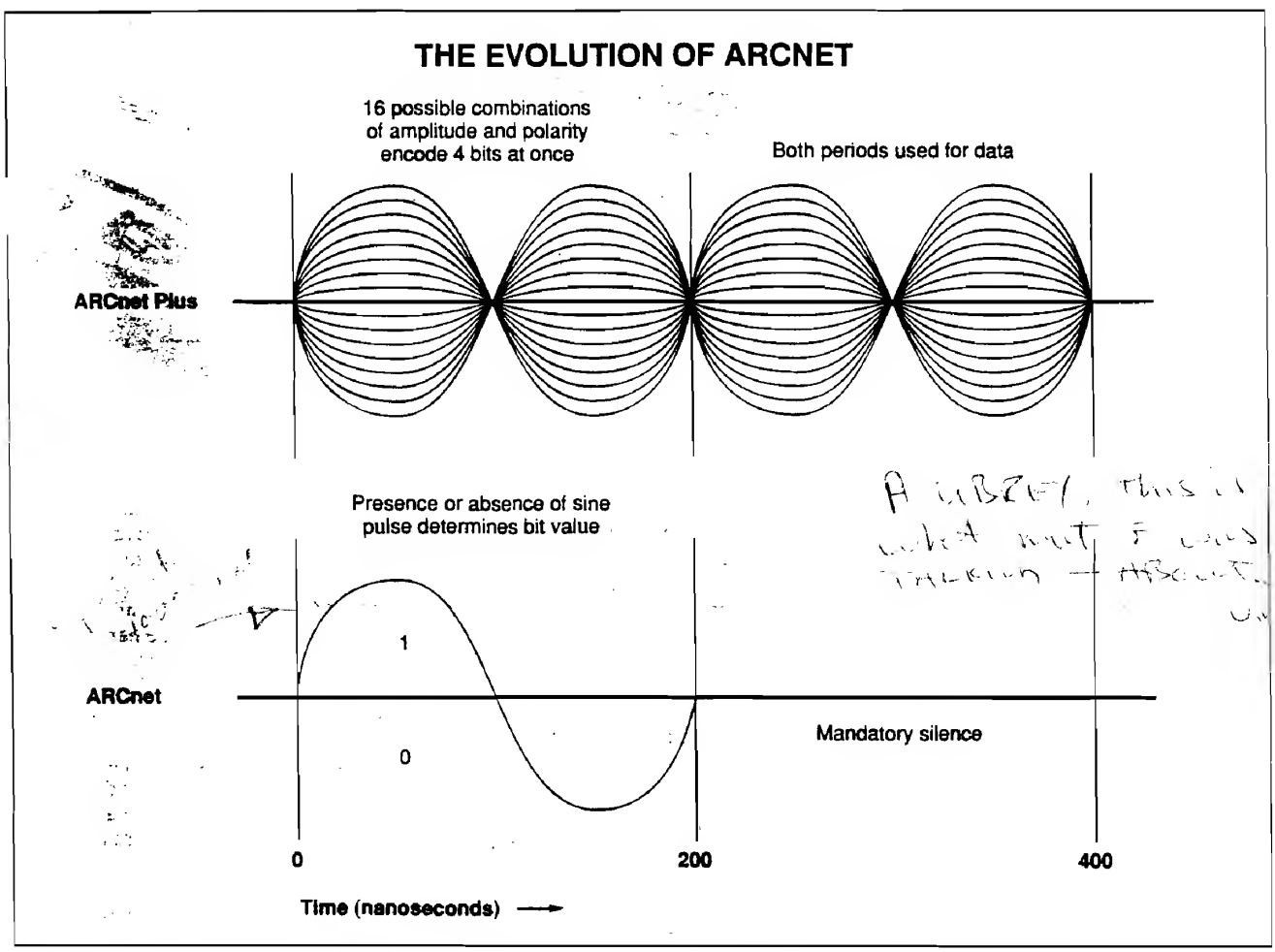
Revving Up the Standard

Despite ARCnet's many advantages, published benchmarks show it lagging far behind other standards in overall throughput. ARCnet proponents realized that they faced the spectre of dwindling market share unless bit rates also kept up with the competition. They also realized that not allowing the new, faster equipment to interoperate with existing units—as was the case when Ethernet and Token Ring moved to higher speeds—might cause users to switch to another standard. Finally, they sought to overcome some other ARCnet limitations, including the 255-node maximum per network and the low 508-byte ceiling on the amount of data per packet.

Datapoint's engineers set a challenging technical task for themselves when they decided to increase ARCnet's speed by a factor of eight *and* retain downward compatibility with 2.5-Mbps ARCnet. How they achieved this goal is extremely clever.

The figure shows how ARCnet Plus works. Nodes on a standard ARCnet signal a "1" bit by sending a 200-nanosecond pulse (consisting of a single cycle of a 5-MHz sine wave) followed by a silence of equal length. Two intervals of silence represent a "0" bit. (To make sure the receiver keeps pace with the transmitter, ARCnet precedes each byte with a 3-bit calibration pattern that consists of two 1s and a 0. This makes the actual data rate $^{8}/_{11}$ of 2.5 Mbps, or 1.82 Mbps.) As you can see, a lot of slack time can be eliminated from this scheme: The periods of silence are wasteful, and the calibration pulses take up 27 percent of the available bandwidth.

ARCnet Plus, like ARCnet, assumes that the base bandwidth of the cable is 5 MHz, but it uses that bandwidth more efficiently. It cuts out the silent period between bits, packing them back-to-back instead. It sends a calibration pattern only once for every 8 bytes, reducing the



The original 2.5-Mbps ARCnet signals bit values by determining the presense or absence of a sine pulse. Here, ARCnet signals a 1" bit by sending a 200-ns pulse, followed by a silence of equal length. The 20-Mbps ARCnet Plus specification makes more efficient use of the bandwidth by using both periods for data and by using amplitude modulation to encode 4 bits into every pulse. ARCnet Plus also sends a calibration pattern once for every 8 bytes, further reducing overhead.